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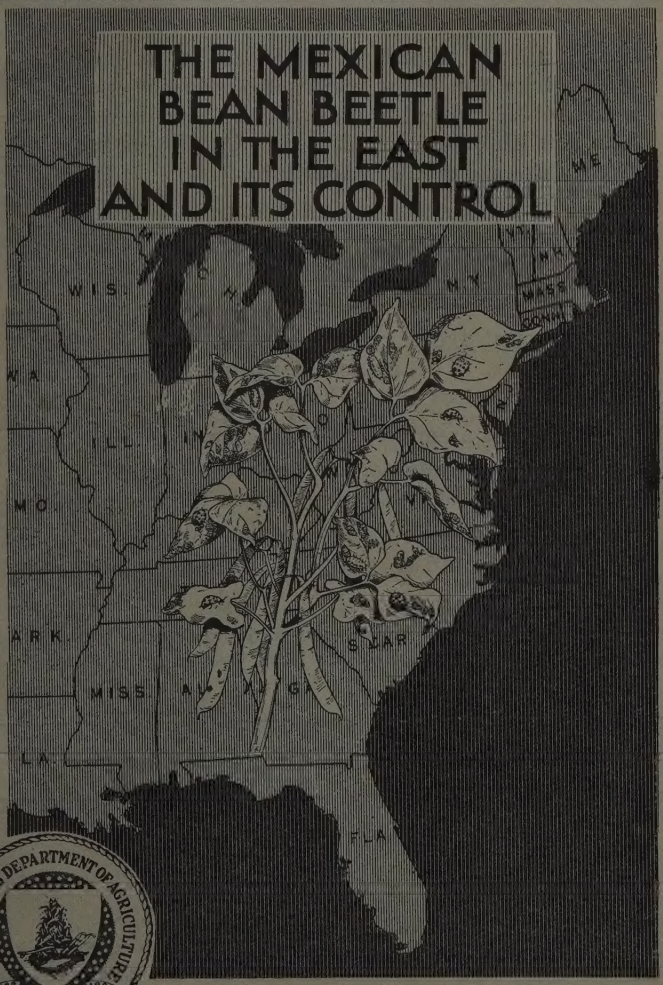
THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL



THE MEXICAN BEAN BEETLE in its range of distribution is the most serious insect enemy of beans in the United States. In the East it was first found in Alabama in 1920, and now infests most of the States east of the Mississippi River.

The adult is a copper-colored beetle, bearing 16 black spots on its back, and is about one-fourth of an inch long. The larva is orange colored and is frequently described as "fuzzy."

This insect feeds on the plants of all kinds of edible beans. The principal injury is done to the foliage.

Magnesium arsenate, used as a spray, is the most satisfactory insecticide. It must be applied to the under surfaces of the leaves, where the insect feeds.

Infested fields should be plowed under as soon as the crop is off, and the grower should not plant more beans than can be properly treated.

This bulletin is a revision of and supersedes Farmers' Bulletin No. 1407, The Mexican Bean Beetle in the East.

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THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL

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THE MOST DESTRUCTIVE INSECT TO GROWING BEANS

THE MEXICAN BEAN BEETLE[1] is the most serious insect enemy of beans in those parts of the United States which it inhabits. It has been long present in the Southwestern States. In 1920 it was discovered at Birmingham and Blocton, Ala. Since that time the pest has spread throughout the greater part of the territory east of the Mississippi River.

APPEARANCE OF INSECT AND NATURE OF DAMAGE

The Mexican bean beetle is a copper-colored, round-backed beetle, with 16 black spots on its back. It is about one-fourth of an inch long and about one-fifth of an inch wide. (Fig. 1, *g*.) The beetle resembles somewhat some of the native beneficial ladybirds.

The larva or immature form is orange colored, varies in length from about one-twentieth of an inch when young to about one-third of an inch when full grown, and is covered with branched spines, which give it a fuzzy appearance.

Injury by the young and adult of the Mexican bean beetle to the bean plant is different from that produced by any other insect which feeds on the beans. The adult, feeding from below, eats ragged areas in the lower surface of the leaf, but often cuts through the upper surface, giving the foliage a lacelike appearance. (Fig. 2.) The larvæ also feed on the under surface of the leaf, but do not cut through the upper surface. The lower tissue is cut away in narrow parallel sections about the length of the insect's body. Between these sections are narrow strips which are left untouched by

[1] *Epilachna corrupta* Muls.; order Coleoptera, family Coccinellidae.

FIGURE 1.—*a*, Eggs of Mexican bean beetle; *b*, *c*, *d*, *e*, first to fourth stages of larva; *f*, pupa; *g*, adult. Enlarged 2½ diameters

FIGURE 2.—Adults and larvæ of Mexican bean beetle on under side of bean leaf, showing areas eaten by adults. Enlarged 2 diameters

the larva, so that the result is a peculiar network unlike any other insect's injury to beans. (Fig. 3.)

Although the leaves are attacked first, all parts of the plant above the ground may be fed upon by both beetle and larva. When the insects are numerous, an injured plant presents the appearance of being completely dried out. (Fig. 4.) After destroying the leaves, the insect will attack the pods, and even the stems.

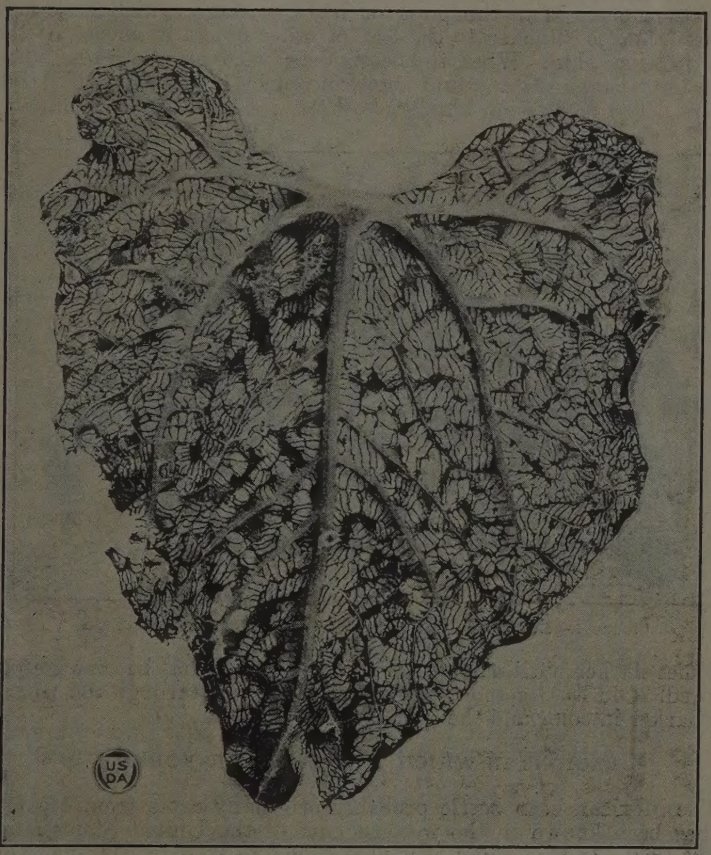

FIGURE 3.—Feeding of larvæ of Mexican bean beetle on bean leaf. Slightly enlarged

When the beetles are abundant, a bean crop may be completely destroyed before the pods are developed.

THE DIFFERENT STAGES

The Mexican bean beetle reproduces by eggs, deposited in clusters of from 40 to 60 on the lower surface of a leaf. (Figure 1 illustrates the different stages of the insect.) The eggs are orange yel-

low in color. The young or larva when first hatched is about one-twentieth of an inch long, and a few hours after hatching it begins feeding. As it grows the larva molts or sheds its skin. When full grown it is about one-third of an inch long and about one-half as wide. The full-grown larva attaches itself to the under surface of a bean leaf upon which it has been feeding or to some other leaf, weed, or near-by object, and becomes shorter but larger around the body preparatory to pupation.

It then changes to the pupa or inactive stage, which is orange colored, and is attached to the leaf or other object by means of the fourth larval skin. When the beetle develops from the pupal stage it is light-lemon colored and shows no black spots upon the wing covers. The spots soon appear, however, and the beetle gradually

FIGURE 4.—Bean plants in field, destroyed by Mexican bean beetle

becomes darker until after a week or 10 days it has become copper colored. Old beetles and those which have lived through the winter are darker in color and the spots are less distinct.

REGIONS IN WHICH THIS BEETLE IS FOUND

The Mexican bean beetle probably originally came from Mexico. It has been known in the western part of the United States since about 1850. In this region it is now known to exist in Arizona, New Mexico, Colorado, Wyoming, and Utah, and has also been recorded from western Texas and western Nebraska.

In many districts of Colorado and New Mexico it is recognized as a very serious enemy of beans and one which has periodically caused heavy losses.

Since its discovery in Alabama in 1920 it has spread to all States east of the Mississippi River except Florida, Illinois, Wisconsin, Vermont, New Hampshire, Maine, and Rhode Island. It extends as far north as southern Michigan, southern and western New York,

and southwestern Massachusetts, and also to the Province of Ontario, Canada, along the northern shores of Lake Erie and Lake Ontario. (Fig. 5.) It has not proved to be a serious pest over all of this region, however; the worst damage has occurred in the area of the Allegheny Mountains and bordering foothills and valleys from northern Alabama and Georgia to southern Ohio and Pennsylvania.

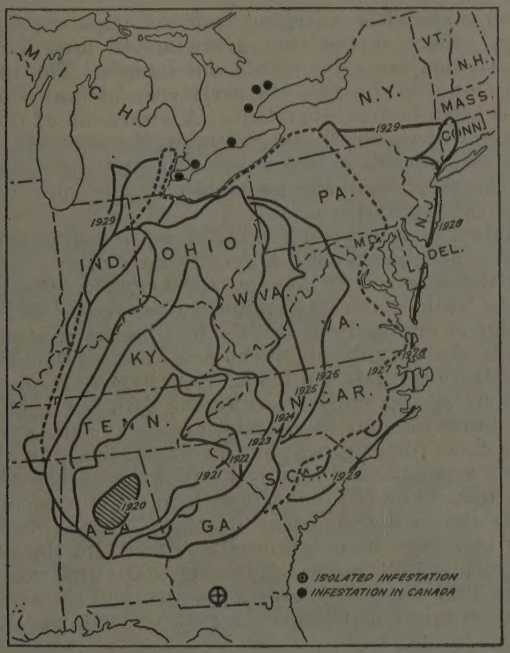

FIGURE 5.—Map showing the known distribution of the Mexican bean beetle in the Eastern States. The heavy lines represent the boundaries of infested territory for each year from 1920 to 1929, inclusive

During 1928 and 1929 it was very injurious in eastern Virginia and Maryland, as well as in the Cape May district of New Jersey.

LIFE HISTORY AND HABITS

The beetles begin to leave their winter quarters in the spring. In the South they first appear in the bean fields in late March or early April, while in southwestern New York they do not appear until June. At intermediate points they appear on different dates, depending on the location. In some places they are present when early beans are still small; in others when the first blossoms appear. After feeding, usually for a week or 10 days, the females deposit their eggs.

Eggs laid in early spring hatch in 10 to 14 days as a rule. As the weather becomes warmer the eggs hatch in less time, in six or

even five days. The young that hatch in the early part of the season develop rather slowly and may require five weeks to complete their growth. Later in the season, however, development of the larvæ requires an average of about 20 days. The pupal period during summer weather averages about seven days. Thus the total period of development from egg to beetle averages about 33 days in midsummer.

Within two weeks after emerging from the pupa the female beetle deposits eggs. Some beetles that overwintered may live for three months, but the majority die within one month. The insect reproduces rapidly, and by the time the early crop of beans has matured the beetle has often become abundant. A maximum of three or even four generations of the beetle may occur in the Southern States, but in the North only one generation or one and a partial second are produced. In the Southwest one generation is the rule, but in some sections a second generation occurs.

The capability of the beetle for rapid reproduction under favorable conditions is remarkable. A female may deposit an egg mass every two or three days. As many as 1,669 eggs have been deposited by one female, while the average number observed is 459.

Late in summer and early in fall the first beetles seek winter quarters, and others follow until about the first frost, at which time practically all beetles have left the fields. All stages are present in the field from early spring until frosts in the fall, but eggs and larvæ may become scarce during late summer and early fall.

The spread from the original point of infestation in northern Alabama has been accomplished mainly by flight, with the assistance of prevailing winds. The beetle is sluggish in its movements, but is a comparatively strong flier and may fly many miles. Marked beetles have, within two days, been captured 5 miles from the point where liberated. During 1921 a spread of over 200 miles northward occurred, and in 1922 a spread of over 100 miles, and the average maximum distance covered in the period 1921 to 1924 was 150 miles a year.

HIBERNATION

Only the adult beetle lives through the winter. It hibernates preferably in woodlands near bean fields. It collects in small colonies. As many as 400 beetles have been found in one group covering an area of about 3 square feet, under pine needles and oak leaves on a well-drained, woodland hillside near cultivated bean fields. (Fig. 6.) Some may remain in the bean fields and others about the field or garden under rubbish and plant remains. The beetles have been found in the winter three-fourths of a mile from the nearest bean field, but the majority occur within a quarter of a mile. In the West the beetle may fly many miles to hibernate. In the Southeastern States complete dormancy does not occur throughout the entire winter, since the beetles move about on warm days.

FOOD PLANTS

The Mexican bean beetle is primarily an edible-bean pest, preferring the common bean, such as snap beans (green or string beans), kidney beans, pinto beans, navy beans, and the Lima bean to other

kinds. Its second choice of food is beggarweed,[2] or beggartick, which grows wild generally throughout the Eastern States and is cultivated for hay in some sections. The insect can reproduce successfully on cowpeas and soybeans, but injury to these crops is unusual.

NATURAL AGENCIES OF CONTROL

No internal parasite of the Mexican bean beetle had been recorded until 1922, when two native species of flies[3] were found to parasitize the insect in rare instances in northern Alabama. They have never become abundant enough to be of any value.

FIGURE 6.—Mexican bean beetle hibernating under pine needles and leaves in woods

A number of predacious insects feed on the eggs and young larvæ, and in some cases on the older larvæ, pupæ, and adults of the Mexican bean beetle. The most common of these in the Southeastern States is the spotted ladybird,[4] which feeds sparingly on the eggs and young larvæ. The "anchor bug"[5] in both immature and adult stages preys on larvæ, pupæ, and adults of this bean beetle. The spined soldier bug[6] attacks all stages. A few other bugs and

[2] *Meibomia tortuosa* and *M. canescens.*
[3] *Phorocera claripennis* Macq. and *Helicobia helicis* Towns.
[4] *Megilla maculata* DeG.
[5] *Stiretrus anchorago* Fab.
[6] *Podisus maculiventris* Say.

a few beneficial ladybird beetles feed on different stages of the bean beetle, but are of little importance.

A tachina fly parasite [7] of this bean beetle is prevalent in some sections of Mexico, and efforts are being made to introduce the species into the United States.

Since the appearance of the Mexican bean beetle in the Southeast, this pest has varied as regards abundance. In general, in the Southeast the numbers of this insect decreased during 1922 and subsequent years until 1928. In 1929 it became extremely abundant over a large part of the Southeastern and Eastern States.

In the West the injury done by this pest to the bean crop has varied from year to year. This has been more or less true in the East, but in many sections the beetle has been sufficiently numerous every year to do serious injury and make the use of control measures necessary. No explanation for this fluctuation can be made other than that weather conditions are probably the most important factors. Heavy rains during the spring and summer seem to be detrimental to the insect. Extreme droughts and hot weather have been observed to act as a material check, especially if the beans suffer from lack of water. Temperature and moisture during the winter are important, and the survival during the winter depends largely on the effects of these factors.

The intense heat in the bright sunlight during hot periods in summer kills many larvæ and pupæ. When dry weather causes the bean leaves to curl, or when varieties of beans which have this habit are grown, many egg masses, larvæ, and pupæ are exposed to the heat and killed.

CONTROL MEASURES

Where the Mexican bean beetle thrives, control measures are essential. The best known remedy for the protection of beans is the application of a spray containing magnesium arsenate. A large number of remedies have been used, but none has given as good results as magnesium arsenate.

MAGNESIUM ARSENATE SPRAY

The recommended spray consists of 2 pounds of magnesium arsenate in 100 gallons of water; or, in smaller quantities, 1 ounce (5 level tablespoonfuls) of magnesium arsenate in 3 gallons of water.

In all experiments tried by the writer 2 pounds of magnesium arsenate to 100 gallons of water has been sufficient, even under conditions of extremely heavy infestation.

To prepare the spray mixture, weigh the proper quantity of magnesium arsenate, then mix it with a small quantity of water, and wash it through a fine strainer into the spray tank in order to prevent clogging of nozzles.

The magnesium arsenate must be applied to the bean foliage where the bean beetle will eat it when feeding, that is, on the undersides of the leaves.

Magnesium arsenate is a stomach poison and therefore not effective until it is taken into the stomach of the insect; hence the in-

[7] *Paradexodes epilachnae* Ald.

sects may not receive a poisonous dose until a day or more after treatment of the crop. It is often difficult to find poisoned insects, since they may crawl into crevices or become shrunken or otherwise succeed in escaping notice.

WHEN TO APPLY THE SPRAY

Begin spraying when beetles are found in the field. If careful observations are made, spraying may be delayed until the eggs of the beetle become numerous, that is, when an egg group may be found on each 10 feet of row, or when the beetles are present in sufficient numbers to cause noticeable injury to foliage. To find eggs, look on the undersides of the leaves. The majority of the beetles will stop feeding directly after the application of the spray,

FIGURE 7.—Power sprayer, showing proper arrangement of boom and nozzles for spraying the undersides of the leaves

but they may be found crawling around over the plant for several days thereafter.

As the beans grow, the new foliage must be covered with the spray; therefore the treatment should be repeated at weekly or 10-day intervals, especially if the pest is abundant. Very often three or even four sprayings are necessary, but as a rule two thorough applications will be sufficient on snap beans. Growers of Lima beans for market must necessarily protect the crop over a longer period.

SPRAY MACHINES

The grower of 4 or 5 acres of beans, or more, should use a horse-drawn power or traction spray machine, which will spray 3 to 8 rows at a time. (Fig. 7.) There is no entirely satisfactory sprayer available for small plantings of 1 or 2 acres which are too large

to be sprayed economically with a compressed-air or knapsack hand sprayer. (Fig. 8.)

Some growers have, however, used a barrel sprayer on a wagon bed or a 2-wheeled cart for small plantings, arranging a boom and two nozzles to direct the spray to the under surfaces of the leaves. Such an arrangement requires the services of two men and hence is not very economical.

It is important that the spray be directed to the undersides of the leaves. To spray the upper surfaces only is almost useless. To reach the under surfaces of the leaves, the spray nozzles should be attached to the discharge pipe by a 90° elbow and a 45° elbow, as

FIGURE 8.—Compressed-air sprayer with hose and extension to reach the undersides of the leaves

shown in Figure 9. When a power or traction machine is used it is well to have a third nozzle placed above the row. (Fig. 7.)

The liquid must be agitated continuously so as to keep the magnesium arsenate from settling in the tank or sprayer.

A pressure of 150 pounds or more is necessary so as to blow the leaves about and insure thorough coverage. Pressure higher than 250 pounds is unnecessary.

New disks should be placed in the nozzles after a total of 10 to 15 hours of spraying. The holes in the disks become enlarged with use, and unless disks are replaced an unnecessary quantity of spray material is used.

The boom should be the proper width to suit the width of the rows, and all fields should be planted similarly so that no adjustment of nozzles will be necessary in spraying different fields.

In the case of young beans the boom should be lowered until the nozzles are about 2 inches above the ground. As the plants grow, the boom may be raised accordingly.

On uneven land it is well to have sections of rubber hose in the vertical outlet pipes, so as to make them flexible and thus prevent breaking of the pipes when passing over rough ground. (Figs. 7 and 9.)

Under certain conditions, when a light or "spotted" infestation occurs on a large planting, it may not be necessary to spray the whole field. In such instances the isolated patches which show beetle or larval injury may be sprayed economically by one man

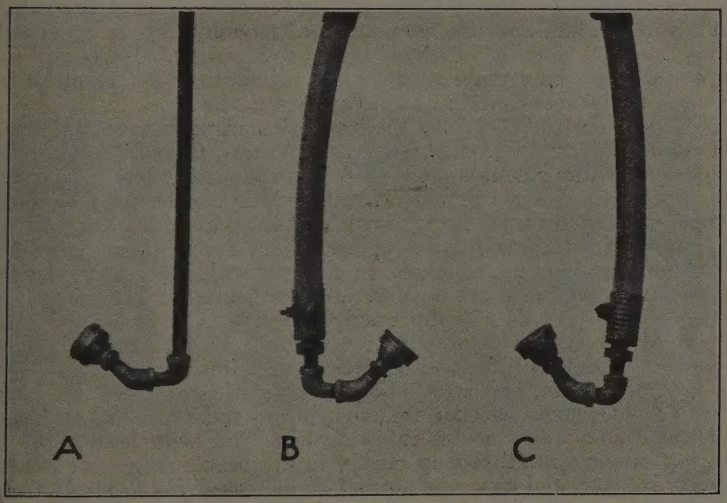

FIGURE 9.—Arrangement of nozzles necessary to spray the undersides of the leaves: A, For hand sprayers; B, C, for power or traction sprayers, with hose sections to prevent breaking pipes

with a 3 or 4 gallon compressed-air sprayer. In this manner the infestation may be so reduced as to save later crops from injury. Some growers have practiced this method with success. The nozzle should be arranged so as to spray the undersides of the leaves. (Fig. 9, A.)

WARNING

Magnesium arsenate is poisonous to human beings and farm animals as well as to insects, and care should be exercised in handling the material to avoid accidents. Since it is primarily a stomach poison, the hands should be washed after handling the material so as to prevent any possibility of getting it into the stomach with food. Any cuts or broken skin on the hands and arms of the operator should be well bandaged to prevent the possibility of irritation from contamination by the arsenical.

It is not recommended that arsenical sprays be applied to snap beans after pods have set. Under usual conditions, careful applications up to the time of full blooming will give sufficient protection.

SUBSTITUTE CONTROL MEASURES

Dusting with arsenical dust mixtures may be practiced, but the results obtained are not as satisfactory as those from spraying. Magnesium arsenate is not entirely satisfactory as a dust, but may be used with 3 parts of hydrated lime and applied at the rate of 15 to 20 pounds per acre. Calcium arsenate may also be used, but many brands are too injurious to bean foliage to be recommended. A number of brands may be used when mixed with 7 parts of hydrated lime or when mixed in the proportion of 15 pounds of the calcium arsenate with 15 pounds of monohydrated copper sulphate and 70 pounds of hydrated lime. Many growers have used a mixture of 20 pounds of calcium arsenate, 20 pounds of monohydrated copper sulphate, and 60 pounds of lime with good results. However, the grower can not be certain that foliage injury may not result from the use of mixtures containing calcium arsenate.

In experiments at Norfolk, Va., reduction in yields resulted from the use of many calcium-arsenate dust mixtures, probably due to the grades of calcium arsenate used. Present knowledge does not permit the specification of a calcium arsenate which can be used on bean foliage without injury. It is known that high humidity, or dusting of plants wet with dew, increases plant injury from calcium arsenate.

Calcium arsenate may be used as a spray with Bordeaux mixture without appreciable plant injury. A Bordeaux mixture prepared with either 3 pounds of copper sulphate, 4½ pounds of hydrated lime, and 50 gallons of water, or 4 pounds of copper sulphate, 6 pounds of hydrated lime, and 50 gallons of water, may be used with 1 pound of calcium arsenate to 50 gallons of the mixture. In addition to the beneficial effect in reducing injury from calcium arsenate, Bordeaux mixture is useful in controlling the bean leaf hopper.[8] While Bordeaux mixture may visibly injure bean foliage, the plants quickly recover, and as a rule normal or increased yields result from its use.

Magnesium arsenate may also be used successfully with Bordeaux mixture.

Lead arsenate should never be used on bean foliage. Serious injury and reductions in yield often result from its use, even with Bordeaux mixture.

Pyrethrum sprays, which are extracts of pyrethrum flowers, may be used successfully, but the high cost of the material makes their use expensive on commercial acreages. When it is necessary to treat snap beans after the pods are present, these extracts are recommended on account of their nonpoisonous qualities. Pyrethrum extract is primarily a contact insecticide and must touch the insect in order to kill it.

PLOWING

As important as thorough spraying is the destruction of the crop remains after picking, especially in the case of snap beans. The

[8] *Empoasca fabae* Harr.

fields should be plowed at least 6 inches deep, special effort being made to cover all the bean foliage. Under usual conditions a high percentage of all stages of the insect may be killed when thorough plowing is done.

There is reason to believe that the Mexican bean beetle could be so reduced in numbers by proper destruction of infested bean crops after harvest, over an area the size of an average county, that less spraying would be required. Benefits derived depend largely on the thoroughness of the disposition of crop remnants.

COMMUNITY COOPERATION

One of the important sources of infestation is the small garden in towns and settlements. A few untreated rows of beans in a neg-

FIGURE 10.—Untreated beans destroyed by Mexican bean beetle beside beans sprayed with magnesium arsenate

lected garden are often the breeding ground of many hundreds of beetles, which may spread to commercial acreages in the vicinity. In one locality in Virginia all garden beans in the neighborhood of large plantings are treated cooperatively. Many canners supply insecticides and hand sprayers to small growers at cost and give advice as to their use, and thus contribute to the control of the beetle to the benefit of the whole community. Similar assistance is given in many sections by the farm bureaus in cooperation with the county agricultural agent.

CULTURAL PRACTICES

The date of planting snap beans to escape injury from the Mexican bean beetle is important in some sections, especially in instances where it is not necessary to have the crop mature at any certain time. No general rule can be made for all the Eastern States. In some sections beans planted very early escape serious injury. In other sections beans planted at the time when the overwintered adults are

disappearing escape serious injury. This is the case in southern Ohio, where beans planted the third week in June may mature without heavy damage, because the overwintered beetles have almost disappeared by the time the beans are out of the ground, and the beans are blossoming by the time the first brood of new adult beetles are numerous.

SUMMARY OF CONTROL MEASURES

The best control for the beetle is magnesium arsenate used at the rate of 2 pounds to 100 gallons of water or 1 ounce to 3 gallons. Proper treatment when beetles are numerous results in an excellent crop of beans, whereas untreated fields are often completely destroyed. (Fig. 10.)

The liquid must reach the undersides of the leaves, and the spraying must be done thoroughly.

Begin spraying when the adults are found in the field or the eggs of the beetle become numerous on the undersides of the leaves.

One to three, sometimes four, applications are required, depending on the abundance of the insect.

Stop spraying snap beans when pods have begun to form.

As important as thorough spraying is the destruction of the crop remains after harvest. Plow under all plant remnants at least 6 inches deep.

Dusting may be practiced but does not give as good results as spraying; and when calcium-arsenate mixtures are used plant injury often results.

Arsenicals are poisonous. Handle them carefully and avoid accidents.

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